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Report No. 14756

PROJECT COMPLETION REPORT

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT
(LOAN 3202-KO)

JUNE 28, 1995

Human Resources Operations Division
Country Department I
East Asia and Pacific Regional Office

CURRENCY EQUIVALENTS

Currency Unit - Korean Won (W)

US$1.00 = W692

(March, 1990)

GLOSSARY

GEC	-	Genetic Engineering Center
GERI	-	Genetic Engineering Research Institute
KAIST	-	Korea Advanced Institute of Science and Technology
KIER	-	Korea Institute of Energy Research
KIGAM	-	Korea Institute of Geology, Mining & Minerals
KRISS	-	Korea Research Institute of Standards and Science
KSRI	-	Korea Standards Research Institute
MOF	-	Ministry of Finance
MOST	-	Ministry of Science and Technology
O&M	-	Operations and Maintenance
PCR	-	Project Completion Report
R&D	-	Research and Development
SMI	-	Small and Medium Industry
TAP I	-	First Technology Advancement Project

FISCAL YEAR

January 1 - December 31

ACADEMIC YEAR

March - February

THE WORLD BANK
Washington, D.C. 20433
U.S.A.

Office of Director-General
Operations Evaluation

June 28, 1995

MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

SUBJECT: **Project Completion Report on Korea - Second Technology Advancement Project (Loan 3202-KO)**

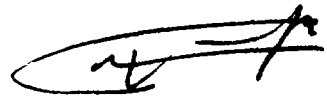
Attached is the Project Completion Report (PCR) on the Korea - Second Technology Advancement project (Loan 3202-KO, approved in FY90), prepared by the East Asia and Pacific Regional Office. Part II was prepared by all five beneficiary institutes.

In its quest to join the ranks of the industrialized countries, Korea has, in the last two decades, been pursuing a focussed and intensive program of human resource and technology development. In addition to expanding and strengthening vocational, technical and tertiary education in science and engineering, the Government created an elaborate institutional framework which, through the Ministry of Science and Technology (MOST), played an important role in coordinating and carrying out R & D programs, provided incentives for the private sector to expand investments in R & D, expanded the provision of credit to finance R & D programs in the private sector, and placed special emphasis on developing technology-based small and medium scale industries.

Through its lending to the education sector and for technology development, the Bank has been closely associated with the technological advancement of Korea. This loan which aimed at providing funds for the purchase of modern equipment by five prestigious national institutes to expand their research and development efforts, achieved its objectives fully. The availability of the new facilities has made it possible for the institutes to increase their research activities, the number of joint projects (frequently with private industry) and their scientific and technical publications. The Korea Advanced Institute of Science and Technology, for example, has increased its intake of post-graduate students from 955 in 1990 to 1339 in 1994 while its contribution to international academic publications has grown from 1117 to 1524 in the same period.

Considering the success of these institutes in improving their laboratories and achieving results, the outcome of this project is rated as satisfactory. The project has had substantial institutional development impact and its sustainability is rated as likely. It is important to note that the Bank's long association with successful technology development in Korea has provided the Bank with many lessons of experience for the design of technology development projects in other countries.

The PCR is of satisfactory quality. No audit is planned.



Attachment

PROJECT COMPLETION REPORT

FOR OFFICIAL USE ONLY

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3202-KO)

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PROJECT COMPLETION REPORT

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT

(LOAN 3202 - KO)

PREFACE

This is the Project Completion Report (PCR) for the Second Technology Advancement Project in Korea for which Loan 3202-KO in the amount of US$31.6 million was approved on May 22, 1990. The loan was closed on schedule on June 30, 1994. The loan account books were kept open to honor applications received before October 31, 1994. The last transaction was made on August 31, 1994. The loan account was closed on August 31, 1994 with a total disbursement of US$31,572,875.49 million or 99.9% of the loan amount.

The PCR was prepared in November/December, 1994 by EA1HR (Preface, Evaluation Summary, Parts I and III). The Borrower's Ministry of Finance was requested to act as the coordinator for the five parts of Part II of the PCR.

Preparation of this PCR was started in June 1993 when a Bank mission requested the five institutions concerned to complete and return Project Review from Borrower's Viewpoint (Part II) and Bank-prepared pro-formas for the preparation of Part III of the PCR. The May 1994 Bank mission followed up with reminders on the pro-formas and the obligations of the borrower for submission of Part II of the PCR to the Bank. Based, inter alia, on the Staff Appraisal Report, the Loan Agreement dated August 10, 1990, the Amendment to the Loan Agreement dated March 3, 1992, supervision and progress reports, correspondence between the Bank and Borrower, and internal Bank memoranda and documents, Bank staff prepared the PCR in November/December 1994.

PROJECT COMPLETION REPORT

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT
(LOAN 3202 - KO)

EVALUATION SUMMARY

OBJECTIVES

(i) The objectives of the project were fully met (paras. 5 and 14). In general the broad aim of the project was achieved in improving the quality of education in a center of excellence in science and engineering education and enhancing the R&D capacity of selected institutions in the fields of biotechnology, standards measurement, energy and resources development and conservation. The impact of the project was positive in all five project institutions (paras. 14 and 15).

IMPLEMENTATION EXPERIENCE

(ii) Overall implementation experience was highly satisfactory. The project closed on schedule with no cost overrun. There were two physical components - equipment financed by the loan and equipment-related civil works, which were financed by the Government. Equipment procurement was very close to target with disbursements of US$31.57 million out of loan proceeds of US$ 31.6 million. Thus actual disbursements were 99.9% of the loan amount. A grace period of four months after the original Closing Date, June 30, 1994, was granted for disbursements on eligible expenditures. There was some delay in equipment procurement at the initial stage of project implementation but this was resolved and did not prevent the timely completion of the project. Cooperation between the Bank and the project institutions was highly satisfactory. This can be attributed to the strong start-up assistance from the Bank and the high quality of local implementation officials. Despite changes in the institutional setup, project implementation was carried out successfully.

RESULTS

(iii) The equipment procured under the project was directly relevant to the project's objectives. The quality of research has been strengthened at the Korea Advanced Institute of Science and Technology (KAIST). This has enhanced the quality of graduate programs by expanding the opportunities for graduate students to become involved in advanced research. The R&D capacity of the Genetic Engineering Research Institute (GERI) has been strengthened to provide greater support to the biotechnology industry. The Korea Research Institute of Standards and Science (KRISS) has enhanced its capacity to design and apply national measurement standards, which contributes to improving the quality of industrial products. The quality of resource survey techniques and R&D in energy conservation has improved at the Korea Institute of the Energy Research

(KIER) and the Korea Institute of Geology, Mining and Minerals (KIGAM) . These institutions now contribute to a more efficient utilization of scarce resources, especially those related to energy generation.

SUSTAINABILITY

(iv) The project institutions are prestige institutions in Korea and receive strong support from their parent ministry (paras. 16 - 19). KAIST is one of Korea's leading education and research institutes in science and technology. Thus it will continue to receive strong financial support and to recruit high quality faculty, thereby ensuring the sustainability of the project's investment. GERI plays the role of training center for Korea's high-level research personnel and as a think-tank for policy-making in the field of biotechnology. KRISS is the central authority of the national standards system. Its crucial role in conducting comprehensive activities related to measurement standards and measurement technology provides vital services to industry. Since Korea is not well-endowed with natural resources, KIER and KIGAM play a significant part in ensuring self-sufficiency in energy sources during rapid industrialization. The high profile of these five institutions with respect to Korea's technology development priorities will ensure continued strong support for them which, in turn, will reinforce the sustainability of the project's investments.

FINDINGS AND LESSONS LEARNED

(v) Project design was consistent with sectoral objectives and with previous Bank lending in technology development and science and technical education in Korea. Project design focused on hardware (equipment and civil works), which was appropriate in view of the well-developed state of the project institutions. They were well-managed, staffed and financed. There was a need for upgrading the teaching and research laboratories to permit the highly-qualified staff to work more effectively. Given the straightforward nature of project design and its successful implementation, there were no major lessons to be learned. Nevertheless, some insight can be gained. Strong initial start-up assistance from the Bank and the dedication of competent local staff enhanced the prospects for successful implementation. Project institutions participated effectively in preparing Part II of the PCR.

PROJECT COMPLETION REPORT

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3202-KO)

PART I. PROJECT REVIEW FROM BANK'S PERSPECTIVE

A. Project Identity

- Project Name: Second Technology Advancement Project
- Loan No.: 3202-KO
- RVP Unit: East Asia and Pacific Region, Country Department I
- Country: Korea
- Sector: Education
- Subsector: Science and Technology

B. Project Background

1. Sector Development Objectives. In support of the Government's industrial restructuring policy, the objectives of the science and technology sector were to:

- develop and utilize technology to the fullest;
- gain continued improvements in productivity;
- expand high value added output which is technologically sophisticated, energy efficient and strongly export-oriented; and
- enhance the role of small and medium industry (SMI) for reducing industrial concentration and over-dependence on imported parts and materials.

In line with these priorities, the education sector's objectives were: to develop R&D capacity in both educational and research institutions; to develop indigenous technology to overcome the increasing difficulty of importing technology from abroad; and to upgrade and restructure the skill mix requirements for meeting the demands of an increasingly technology-intensive industrial sector.

2. Policy Context. The Government placed heavy emphasis on the need for restructuring industry towards more technology-intensive fields as the prospects for further expansion of labor-intensive industries became more limited. To achieve this objective, the Government created an elaborate legal and institutional framework which established an important public sector role in coordinating and carrying out R&D programs, provided incentives for the private sector to expand investments in R&D, strengthened and expanded the provision of credit to finance R&D programs in the private sector, and placed special emphasis on developing technology-based small and medium industries.

3. Research and Development. The growth of R&D in Korea underwent three major changes. First, the emphasis in the early stage on Government expenditures changed to the predominantly industry-funded contributions

following the introduction, in the 1970s, of incentives for the private sector to expand R&D expenditures. Second, the total R&D expenditures increased from 0.6% of GNP in 1980 to 2% in 1986 and are planned to reach 3% by 1995 and 5% by 2001. Third, the ratio of scientists and engineers (the basic human resource for R&D), is planned to increase from 13 per 10,000 population in 1986 to 30 per 10,000 by 2001. Further, the National Project scheme has been introduced to develop broader technological infrastructure in priority areas, strengthen linkage between industry and public R&D institutes, and promote research on industry-initiated topics under joint ventures between SMI and contracted research institutes.

4. Science and Technology Education. In Korea, the development of education at the secondary and higher levels has generally borne a close relationship to the country's economic development, especially in relation to industrial growth and restructuring. The shift from labor-intensive to capital-intensive and increasingly to technology-intensive industry has been accompanied by appropriate changes in the education system. Early emphasis was placed on vocational and technical education to produce skilled workers. This was followed by an expansion of junior technical colleges to train industrial technicians. As the economy moved towards more technology-intensive production, greater emphasis was placed on undergraduate science and engineering programs to produce professional scientists and engineers. Priority was also given to graduate education in these fields to supply key R&D personnel.

C. Project Objectives and Description

5. The broad aim of the project was to reinforce the Government's strategy for technology-intensive industrial development by improving the quality of education in a center of excellence in science and engineering education and strengthening the capacity of selected R&D institutions.

6. The project financed specialized equipment associated civil works and equipment-related consumable materials and O&M expenditures for KAIST, GERI, KIER, KIGAM and KRISS. The equipment lists were reviewed rigorously in each institution. More specifically, project inputs aimed to: improve the quality of research at KAIST by updating research equipment and providing state-of-the-art equipment to strengthen its research programs; strengthen the R&D capacity of GERI and the quality of its support to the biotechnology industry; enhance the ability of KIER and KIGAM to undertake resource surveys, strengthen R&D in energy conservation and provide technical support to industry; and enhance the ability of KRISS to improve national measurement standards and to provide technical support to industry. Civil works for GERI and KRISS to house some of the equipment were financed by government.

D. Project Design and Organization

7. The project was based on previous Bank support for technology development in Korea during the last decade, focusing on financing R&D projects through financial intermediaries, strengthening those intermediaries and the development of technical and scientific education. At the time of

preparation, the Bank had financed projects in electronics technology, industry promotion (including Small and Medium Industry) and the first Technology Advancement Project. The Bank had assisted technical and science education through seven loans which supported industrial development. Finally, the Bank had also provided general support for industrial development through a series of loans to local development banks and through an IFC loan to assist the commercialization of new technology. The conceptual framework for the project reflected this Bank experience, and it was clearly stated in the SAR. The project was designed over a fifteen month period, with inputs from the Government's central planning authorities, participating ministries/ institutions and Bank staff/consultants. Following the Bank's approval of the project, there were no significant changes in project design.

8. The scope and scale of the project were appropriate since it continued to offer support in those areas in which the Bank had previous experience while addressing the needs of five national institutions which the Government had identified as requiring additional quality-improving investments. The development of these institutions (KAIST, GERI, KIER, KIGAM and KRISS) further strengthened the research capacity of Korea's leading graduate school in science and engineering and improved R&D capacity in the fields of biotechnology, standards measurement and in energy and resources development and conservation. The project design's focus on hardware (equipment and civil works) was also appropriate. The project institutions were found to be well-staffed by highly-qualified researchers, efficiently managed and well-financed. Their objectives were clearly stated and these were closely related to Korea's education and technology development priorities. The main weaknesses were in the physical aspects of laboratory provision and these were addressed under the project. Upgraded laboratories were viewed as essential to increasing the effectiveness of teaching and research staff.

9. The design of project management centered on the five institutions, each of which was responsible for the implementation of its part of the project, under the budgetary oversight of the Ministry of Science and Technology (MOST). All five institutions excelled in their coordination with the Bank during project implementation, and also during the preparation of the PCR. Based on lessons learned from Ln. 2427-KO[1], the Bank requested that the Ministry of Finance (MOF) coordinate the preparation of Part II of the PCR. This was carried out successfully and all five project institutions submitted their respective Part IIs on schedule.

E. Project Implementation

10. Comparison of "Planned" versus "Actually Performed" in Project Implementation. There were two physical components in the project. One was civil works which was financed by the Government; the other was equipment which was financed by loan proceeds. Equipment is dealt with first. For

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[1]In para. 8 of Part I of the PCR for Ln. 2427-KO dated May 17, 1991, it was stated that there was a need for a coordinator to oversee the preparation of the PCRs for projects dealing with more than one institution.

KAIST, procurement of 376 items of equipment was planned with an estimated cost of $12.0 million. GERI selected 61 items of priority for procurement and the estimated cost was $4.0 million. For KAIST, the "Actually Performed" figure was 370 items and the contract cost was $11.99 million. For GERI, the "Actually Performed" figure was 83 items and the contract cost was $ 4.00 million. For KIER, 23 items were planned whose estimated cost was equivalent to the estimated loan allocation of $3.2 million. Procurement of 25 items at a cost of $3.19 million was achieved. The difference was also minimal. For KIGAM, 32 items were planned whose estimated cost was equivalent to the estimated loan allocation of $6.4 million. Procurement of 33 items at a cost of $6.39 million was achieved. KRISS procured 61 items, and the contract cost was $5.99 million, which was within KRISS's loan allocation of $6.0 million. As a whole there was no cost overrun. Out of the total loan amount of $31.6 million, $31.56 million was spent on equipment. There was also no time overrun on equipment procurement, as evidenced by the on-schedule loan closing.

11. For civil works, the physical facilities required to house the equipment procured under the project already existed at all institutions, with the exception of the KRISS and a few laboratories at GERI. On the basis of available data, it was not possible to compare "Planned" with "Actual" achievements for the civil works component for KRISS and GERI. However, supervision missions found that construction at both institutions were completed in time for the installation of equipment.

12. Project Risks. There were no major risks foreseen during appraisal. No major problem occurred during implementation. The amount of loan cancellation was $27,124.51, or about 0.09% of total loan amount, and this can be regarded as negligible. A minor problem occurred in 1991 when the original Korean Institute of Energy and Resources (KIER) separated into two institutions, one for energy (Korean Institute of Energy Research - KIER) and one for resources (Korean Institute of Geology, Mining and Minerals - KIGAM). These structural changes led to a small delay in disbursements. The Special Account of the defunct institution had to be closed and separate Special Accounts established for the two new institutions. However, due to the low balance amount of the Special Account in the defunct institution, there was an urgent need of funds to finance contracts already signed. As a result, the two new institutions faced temporary financial difficulties in obtaining replenishment from the Bank before the establishment of the two new Special Accounts. However, this did not affect the timely completion of the project. The disbursements were completed during the four month grace period. There was also no problem regarding compliance with covenants (Table 9), submission of audit reports including separate opinion on statement of expenditures (Table 9) and timely submission of progress reports (Annex 2).

13. There were no unforeseen factors which affected project implementation, and there were no actions or decisions taken which affected implementation negatively. There were three changes of names and jurisdictions, namely:

a) Korea Research Institute of Energy Resources (KIER) split into:

   i) Korea Institute of Energy Research (KIER), and

   ii) Korea Institute of Geology, Mining and Materials (KIGAM); with jurisdiction for both institutions still under MOST.

b) Genetic Engineering Center (GEC) became Genetic Engineering Research Institute (GERI), but still under the jurisdiction of MOST.

c) Korea Standards Research Institute (KSRI) became the Korea Research Institute of Standards and Science (KRISS) which remained under the jurisdiction of MOST.

These changes were unforeseen events and did not produce any adverse effect on project implementation.

F. Major Results of the Project

14. Project Objectives. The objectives of the project were met.

- The quality of science and engineering education and research at the KAIST has been strengthened. This has enhanced the quality of graduate programs by expanding the opportunities for graduate students to become more involved in advanced research.

- The R&D capacity of GERI has been strengthened to provide greater support to the biotechnology industry. KRISS has enhanced its design and application of national measurement standards which contributes to improving the quality of industrial products. The quality of resource survey techniques and R&D in energy conservation has improved at KIER and KIGAM. They now contribute to a more efficient utilization of scarce resources especially those related to energy generation.

- The equipment procured with the loan proceeds was relevant to the project's objectives and has increased the research capacity at KAIST, GERI, KIER, KIGAM and KRISS. The loan financed 572 key pieces of research equipment, virtually all of which had been installed and were being used by all institutions at the time the project closed.

15. Impact of Project. The impact of the project is positive on all five institutions. The assessment is as follows:

(a) KAIST

KAIST is an elite graduate school in Korea. The high quality engineering training at KAIST cannot be achieved without sound experimental work in laboratories and solid practical work in workshops. Well-equipped laboratories and workshops are prerequisites for the attainment of this goal.

The 370 pieces of equipment supported by the project has contributed to the increasing volume of research projects from Won 14.4 billion in 1990 to Won 32.8 billion in 1993. In additional, the increasing trend is also evident in the number of published articles from 1,117 in 1990 to 1,524 in 1993.

(b) GERI

In addition to what was stated in para. 14 above regarding GERI, the research capacity, in both qualitative and quantitative terms, has also been enhanced. Equipment financed under the project, concentrated in the Division of Technology Service (DTS), has contributed to strengthening both GERI's own research capacity and research in the broader field of biotechnology through DTS' technical support services to outside research institutes in the universities, government and industry, especially the SMI sector. The US$4.0 million of equipment has assisted GERI in improving its capacity for product testing and associated data processing, strengthening identification and storage capacity for micro-organisms, and improving quality control in the production of biological specimens. The equipment supported a generally expanding trend in GERI. The number of publications increased from 65 in 1990 to 130 in 1993. The annual allocation of the R&D budget was raised from US$ 5.4 million in 1990 to US$ 14.0 million in 1994, and the number of R&D projects increasing from 160 to 210 during the same period.

(c) KIER and KIGAM

For both KIER and KIGAM, the project has positively supported the full range of their major activities. KIER has strengthened its focus on energy conservation including the development of more efficient furnaces, boilers and air conditioning systems and on energy utilization. R&D activities have been increased in areas of new and renewable energy sources such as solar, wind, methane gas, etc. KIGAM has improved its work on geological mapping, oil and mineral resource surveys and the development of improved methodologies related to these activities. R&D capacity has also been enhanced in mining technology, especially related to coal. The equipment supported by the project has contributed to the increasing volume of research projects from Won 10 billion (194 projects) in 1992 to Won 16.3 billion (214 projects) in 1993. In additional, the increasing trend is also evident in the number of contract research projects which grew from 73 in 1992 to 81 in 1993.

(d) KRISS

KRISS's strategic role has been strengthened to maintain national measurement standards and develop improved measurement standards and techniques. With the modern equipment financed under the project, it has been able to focus effectively on developing techniques for measuring, testing and analyzing properties and defects of materials. KRISS's research publications increased from 294 articles in 1990 to 409 articles in 1993. The number of patents produced also increased from 12 between 1977-1990 to 18 between 1991-1994. As a result, KRISS is making a strong impact on ensuring product quality, safety and environmental standards, all of which are vital to Korea's technological advancement.

G. Project Sustainability

16. The Government's continued high priority on science and technology will ensure the sustainability of all five project institutions. The Government's dependency on KAIST to produce the highest level scientific and technological manpower and to serve as a major research institute, assures the sustainability of this institution. The strong support of MOST for the well-being of KAIST, one of Korea's most prestigious institutions, further guarantees that KAIST will not face adverse conditions, such as lack of budgetary provision. The high prestige that KAIST has enjoyed in the last two decades in Korea will also ensure that it will continue to recruit high-quality faculty without difficulty.

17. To enter the ranks of technologically advanced countries, the government is placing strong emphasis on upgrading the research capacity of the national institutes, the very foundation of technology development. This is to achieve the objective of reinforcing local creative abilities in science and technology which in turn would strengthen Korea's capacity for technological innovation and reduce dependence on imported technology. GERI was established to lead this effort in the area of biotechnological research. Its valuable technical support services to outside research institutes in the universities, government and industry assure its sustainability.

18. In the midst of rapid industrialization, Korea is poorly endowed with natural resources. The need to seek alternate sources of energy is, therefore, critical. The strong support for KIER and KIGAM is evidenced by the creation of these two new institutions from the original KIER. KIER's and KIGAM's vital functions in energy conservation and development will make them sustainable in the future.

19. To ensure competitiveness abroad, KRISS's role in conducting R&D activities on measurement standards and measurement technology lie at the heart of this effort. Quality control and increasingly complex technology require continued improvements in measurement standards. KRISS, therefore, plays a strategic and pervasive role in Korea's technology advancement.

H. Bank's Performance During Project Cycle

20. Major Strengths and Weaknesses. Bank's performance on this project was in general satisfactory. Design and implementation of the First Technology Advancement Project (TAP I) have led to the development of standardized documentation for project preparation and implementation. This reduced substantially the number of staff weeks required for project design, processing and implementation, thus increasing the cost-effectiveness of project activities. The time spent on the early part of the project cycle, from identification in mid CY89 to loan signing in late CY90, is below average. The staff input during this period was 16.5 staff weeks, which is significantly lower than 33.5 staff weeks for the first project. Bank staff assistance during project implementation was effective in providing timely advice on procurement issues and ways to avoid extension to the Closing Date. This was achieved with total staff input for supervision of about 12.6 staff weeks (Table 10) as compared to 23.7 staff weeks for TAP I. The success of

the project also reflects the strong cooperation the Bank received from highly competent local officials. The Bank's estimates for the completion of components and loan disbursements were overly optimistic (Tables 3 and 4) but this did not pose a problem since all project activities were completed by the Closing Date and within the grace period for disbursements.

21. Lessons Learned. Given the successful implementation of the first project and the simplicity of this project design, there were no major lessons to be learned.

I. Borrower's Performance During Project Cycle

22. Major Strengths and Weaknesses. The performance of all five project institutions was outstanding. Both KRISS and KIGAM successfully completed implementation by mid 1993 which was far in advance of the other institutions. All institutions made significant progress per Bank's advice and the disbursement process was finalized within the grace period. Work on the PCR was also excellent. There was neither cost nor time overrun. With the exception of KAIST, all of this was achieved without any prior experience in Bank project implementation. Moreover, the cooperation with all Bank missions during the whole project cycle was impeccable. KAIST had prior experience with Bank project implementation and therefore only a minimal effort was required from Bank visiting missions.

23. Lessons Learned. Again, there were no major lessons to be learned. However, two points are worth noting: 1) institutions without prior experience with implementation of Bank projects can perform well; and 2) despite structural and jurisdiction changes of project institutions, implementation can still be effectively carried out without any delay. This may have resulted from effective start-up assistance and timely support from the Bank, and the dedication of competent local implementation staff.

J. Project Relationships

24. Impact of Relationships on Project Implementation. The relationship between the Bank and the five institutions in this project was excellent throughout the project implementation period. Early emphasis by Bank staff on implementation requirements and the receptiveness of competent local staff to this advice contributed significantly to the successful outcome. Close coordination of MOF with all project institutions provided prompt submission of Part II of the PCR. The relationships, such as those between the Bank and MOST and those between project institutions and industry were satisfactory.

K. Consulting Services

25. There was no technical assistance in this project. There were also no studies or fellowships.

L. Project Documentation and Data

26. Adequacy of Staff Appraisal Report, Major Working Papers and the Legal Agreement. There is no evidence of any inadequacy in the Staff Appraisal Report, the working paper or the Loan Agreement.

PART II. PROJECT REVIEW FROM BORROWER'S PERSPECTIVE

IBRD Loan No. 3202-KO
KAIST Project

Second Technology Advancement Project
Project Completion Report

September 1994

Korea Advanced Institute of Science and Technology

Second Technology Advancement Project (Part A)
Project Completion Report (Loan 3202-KO)

1. Objective of the Project

The objective of this loan project was to meet increasing need for procuring equipment which are required for educating a growing number of students. Since the relocation of the institute from its Seoul campus into Taedok, KAIST has undergone substantial expansion in terms of the size of the campus and of the number of student. The number of student increased from 3,128 to 5,820, as a result of merging with undergraduate levels. The size of the building, from 58,051 sq.m to 295,389 sq.m., and the entire campus size, from 109,787 sq.m. to 1,213,198 sq.m. The prerequisites for such expansion was to acquire research/academic facilities and equipment enough to train its students, and this has necessitated KAIST, in consultation with the Korean government, to launch and IBRD loan project in the amount of US$12,000,000.

The loan, thus granted to KAIST, was applied to financing the acquisition of research/academic facilities for the 20 departments, computer center, and joint research labs. Prior to loan application, KAIST has undertaken a sufficient study in handling and scheduling the fund supply.

However, the fund of US$12,000,000 was not sufficient enough for KAIST to fulfill adequately the rising facility/equipment demand. Thus, KAIST is continuously seeking financial means to upgrade its academic faciliti es.

2. Effect of the Loan Application

As a result of effective fund application, KAIST was able to achieve a favorable result as follws:

1) Fund investment plan and result

(Unit: US$1,000)

Investment period	'90	'91	'92	'93	'94	Total	Outcome(%)
Plan	4,100	4,000	3,900	-	-	12,000	100
Outcome	-	30	5,360	4,134	2,470	11,994	99.95

*The amount in "Outcome" is based on the figure drafted out of the Special Account of the KEB.

2) Description of fund application (in terms of equipment purchase/expansion)

Applied Area	No. of Eqmt	Amount(S1,000)	Remarks
Educational Equipment for 20 depts	347	8,860	
Computer Equipment	21	3,024	
Joint Lab Equipment	2	110	
Others	-	-	
Total	370	11,994	

3. Effect of the Project

The loan project has helped KAIST to upgrade its ability to perform world-class research activities; its students are actively participating in cutting-edge researches in basic science and applied engineering.

The loan was applied to finance acquisition of equipment of 370 kinds which were mainly distributed to 20 departments, computer center, and joint research labs. Consequently, it may be assessed that the increase in lab equipment per professor is equivalent to U$40,000 in value, U$2,200 per student.

The loan has enabled KAIST to increase its enrollment and output of students, to recruit sufficient number of faculty members which resulted in increased number of thesis publication.

- Faculty Recruitment

(Unit: Person)

Year	'90	'91	'92	'93	'94(As of May)
Recruited	8	17	7	4	8
Total No. of faculty	298	313	322	326	329

*The total number includes Seoul campus faculty

- Student Recruitment and Output

(Unit: Person)

		'73~'89	'90	'91	'92	'93	'94	Total
Recruitment	BS	2,064	547	543	570	578	558	4,860
	MS	6,669	604	655	589	696	806	10,019
	Ph D	2,210	351	362	437	559	533	4,452
	Total	10,943	1,502	1,560	1,596	1,833	1,897	19,331
Output	BS	23	391	381	422	443	497	2,157
	MS	5,311	532	530	582	622	623	8,200
	Ph D	718	186	247	274	268	318	2,011
	Total	6,052	1,109	1,158	1,278	1,333	1,438	12,368

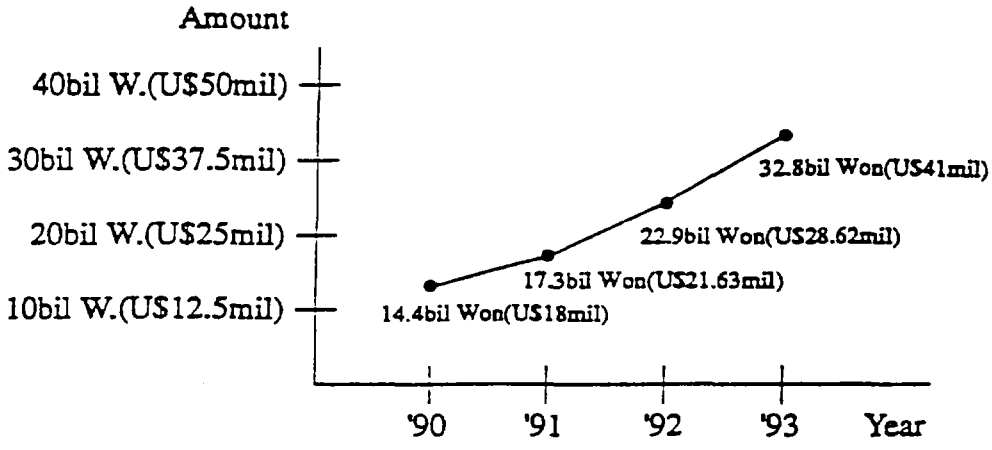
- Faculty contribution in domestic and international academic publications

(Unit: publication)

Classification	'73~'89	'90	'91	'92	'93	Aggregate
Domestic	2,709	503	333	596	511	4,652
Int'l	3,038	614	725	822	1,013	6,212
Total	5,747	1,117	1,058	1,418	1,524	10,864

As a result of the loan, the faculty result output has increased remarkably. Accordingly, faculty's technology assistance to government and industry sponsored research activities has increased, too.

In 1993, the research outcome has amounted to a worth of U$41 million (32.8 billion won), and the amount is on the rise. The recent research outcome is as follows:



*The aggregate of KAIST's research output since its inception amounts to U$15.772 million (126.2 billion Won)

4. Conclusion

The loan project has been successfully implemented, and we are grateful to IBRD and the Korean government for their cooperation. The loan of U$12,000 has brought forth procurement of lab facilities which rendered a more favorable research environment, and as a result of this, KAIST was able to establish interdisplinary cooperation network among industry, academies, and research institutions. In addition, the loan project has helped tremendously to recruit greater number of students while supporting quality research works. Now, KAIST is continuing in its effort to train higly talented students who will later lead the scientific and technological advancement of the nation and of the world.

5. Recommendations

. It would be helpful for executing the loan if the deposit limit in the special account is upgraded from 10% of the total loan amount to 20%.

. It is recommended that the total amount requested by the borrower be deposited into the special account by the closing date, and the amount is not withdrawn from the special account since the closing date.

IBRD Loan No. 3202-KO
GERI Project

Completion Report
of
Second Technology Advancement Project

September 1994

Genetic Engineering Research Institute

1. Summary of the Project (Part B)

The objective of this loan project was to improve GERI's biotechnology R&D capacity through acquisition of specialized equipment and consumable materials.

As the main institute in Korea for life sciences and biotechnology, GERI's mission is to develop relevant technologies, strengthening the foundation of research, training researchers and personnel, and significantly raising the level of national biotechnology research capability. Since the relocation of the institute from Seoul into Taedok Science Town, GERI has undergone substantial expansion in terms of the size of the building and of the number of researchers. The number of researchers increased from 120 to 143 and the size of the building was enlarged from 777 sq.m to 8,604 sq.m. And this has necessitated GERI, in consultation with the Korean government, to launch an IBRD loan project in the amount of US4,000,000 to accomplish the mission.

The loan, thus granted to GERI, was successfully allocated to financing the acquisition of R&D equipments necessary to fulfill the R&D projects of GERI.

2. Results of the Project

GERI has satisfactorily completed the loan implementation as follows ;

1) Loan withdrawal by Year

Year	'92	'93	'94	Total
Withdrawal (Unit : US$1,000)	156	1,189	2,655	4,000

2) Description of Loan Execution by Category

Category	Numbers	Amount (Unit : US$1,000)
R&D Equipments	83	4,000
Others	-	-
Total	83	4,000

3. Effect of the Project

The loan Project has helped GERI to upgrade its capability to perform biotechnology R&D activites at a highly advanced level .

The loan was spent to purchase the 83 kinds of R&D equipment. which was followed by the dramatic increase of the mumber of R&D projects and new researchers as well as the expansion of the amount of R&D budget during the Project period.

- Recruitment of New Researchers (Unit : Person)

Year	'90	'91	'92	'93	'94 (As of June)
Recruited New Researchers / Total Researchers	27/129	22/144	12/146	6/146	6/143

- Publications made by GERI

Year	'85-'89	'90	'91	'92	'93	Total
Domestic Publication	162	49	92	110	94	507
Int'l Publication	59	16	30	32	36	173
Total	221	65	122	142	130	680

- R&D Budget & the Number of Projects.

Year	'85-'89	'90	'91	'92	'93	'94	Total
R&D Budget (Unit : Mil US$)	15.3	5.4	4.7	8.4	11.1	14.0	58.9
The number of projcets	558	160	143	157	191	210	1,419

* US$1 = ₩800

* In 1994, the R&D budget, which is on the rise, is equivalent to 14 mil. US Dollars

4. Conclusion

The loan porject has been successfully implemented thanks to help of IBRD mission.

However, the loan of US$4,000,000 is not sufficient enough for GERI to fully meet the rising R&D equipment demand. Thus, GERI is continuously seeking financial

means to upgrade its R&D capabilities.

5. Recommendations

It would be more desirable in executing the IBRD loan if the special account deposit limit is adjusted upward from 10% to 20% of the total loan amount.

IBRD Loan No. 3202-KO

KIER Project

Second Technology Advancement Project
Project Completion Report

September 1994

Korea Institute of Energy Research

The Second Technology Advancement Project

- Part D. Loan 3202-KO -

Project Completion Report

1. Objective of the Project

The objective of this loan project was to procure the latest research equipment for Korea Institute of Energy Research(KIER) to successfully carry out its assignment of technology development in the sector of energy.

2. Scope of the Loan Applications

The project started in August 1990 and ended in June 1994. The total loan amount made available to the former Korea Institute of Energy and Resources was $9,600,000. A governmental action in November 1991 to reorganize the Institute created two new research organizations. In this context, the government reallocated $3,200,000 to KIER and 6,400,000 to Korea Institute of Geology, Mining and Materials(KIGAM) out of the said amount.

The loan money was not earmarked for KIER's addition of new facility construction, and the whole was expended in purchasing research equipment and devices.

3. Result of the Project

Table below shows the numbers of equipment purchased on an annual basis. A complete list of procurements is given in Appendix hereto.

	1991	1992	1993	1994	Total
No. of procurements	1	2	16	6	25
Amount disbursed($)	118,000	701,164.04	1,746,760.01	621,543.18	3,187,467.23
Percentage(%)	3.7	21.9	54.6	19.4	99.6
					*Free balance : $12,532.77

4. Conclusion and Recommendations

It is viewed that the IBRD loan project has been successfully completed, and we would like to return our deep thanks to the Bank and the Korean government for their loan arrangements and other cooperation. We think that the loan equipment will greatly help upgrade research effectiveness in energy sector with reference to technology diversification and energy conservation.

The ordained rule, when executed, of placing equipment orders through the Korean Office of Supply (OSROK) took too long a time of delivery, sometimes, up to more than 12 months. This would result that responsible users could not meet the need of putting them into operation in a timely manners. It is desirable to leave to users' discretion in placing orders, say, direct orders with suppliers, as the case may be.

It is also recommended that the Bank include an item of equipment training money so that practical operators could learn suppliers' techniques on how to operate them prior to delivery. In fact, the trainees, sometimes, had to go to suppliers' site for that purpose at the expense of their own research budget. In view of a research budget constraint, we think that this pattern of technical training for operators would be undesirable.

Status of Item Purchases under IBRD Loan Program

ITEM NO.	I t e m	Q'ty	Contract No.	Money Contracted ($)	Date Contracted	Date of Delivery	Amount Payed ($)	Remarks
1	Flow Visualization System	1set	IBRD/L-KOS -912464-F3	- 118,000	91.11.13	91.12.18	118,000	
2	Scaning Tunneling Microscope	1set	IBRD/L-KOS -912573-F3	215,445	91.11.19	92.10. 8	213,782.78	
3	Scaning Electron Microscope	1set 1set	IBRD/L-KOS -920140-F3 IBRD/L-KOS -920139-F3	(UK 41,334.85) 60,380.56 (NFR665,250) 418,000.70	92. 1.30	92.10. 8	487,381.26	
4	Secondary Refrigerant Calormeter	1set	IBRD/L-KOS -922669-F3	KRW (284,520,000) 362,769.35	92. 9.14	93. 9.15	348,588.65	
5	Energy Disversive Z-Ray Fluorescence Analyzer	1set	IBRD/L-KOS -930850-F3	150,000	93. 4.13	93.10.28	150,000	
6	Fourier Transform Inrrared Spectrometer	1set	IBRD/L-KOS -930325-F3	26,100	93. 2.17	93. 9. 1	26,100	
7	Heat Exchanger Performance Test Loop	1set 1set 1set	IBRD/L-KOS -933804-F3 IBRD/L-KOS -932465-F3 IBRD/L-KOS -932852-F3	179,628.89	93.11.23 93. 8.24 93. 9.17	94. 6 2 94. 1.25 94. 3. 4	179,526.90	

ITEM NO.	I t e m	Q'ty	Contract No.	Money Contracted ($)	Date Contracted	Date of 일 Delivery	Amount Payed ($)	Remarks
8	CAD System	1set	IBRD/L-KOS -932763-F3	88,506	93. 9.1 0	93.12. 8	88,300	
9	Photovoltaic Module Test(Laser Area Pulsed Solar Simulator)	1set	IBRD/L-KOS -931009-F3	140,300	93. 5. 3	93. 9.24	140,033	
10	Automatic Calormeter	1set	IBRD/L-KOS -930326-F3	32,900	93. 2.1 7	93. 9. 1	32,874.94	
11	Thermogravimetric Analyzer	1set	IBRD/L-KOS -930852-F3	31,250	93. 4.1 3	93.10.26	31,210.18	
12	Thermal Analyzer	1set	IBRD/L-KOS -931873-F3	60,523	93. 7.1 4	93.12. 7	59,086.67	
13	Fludized-Bed Reactor System	1sys	IBRD/L-KOS -930853-F3	(SFR 114,000) 78,349.85	93. 4.1 3	93.10.28	78,349.85	
14	Thermoelectric Cogenerator and Thermoelectric Cooler Test Roof	1sys	IBRD/L-KOS -931350-F3	289,371	93. 5.2 7	93.12.24	289,371	
15	Inductively Coupled Plasma Spectrometers	1set	IBRD/L-KOS -931875-F3	113,150	93. 7.1 4	94. 3.10	111,650	
16	Automatic Elemental Analyzer	1set	IBRD/L-KOS -931874-F3	53,170	"	93.11.24	53,170	
17	Automatic Sulfur Determinator	1set	IBRD/L-KOS -931874-F3	63,880	"	93.11.24	63,880	

ITEM NO.	I t e m	Q'ty	Contract No.	Money Contracted	Date Con - tracted	Date of 입 Delivery	Amount Payed	Remarks
18	Bolt-on AES Analysis System	1set	IBRD/L-KOS -930851-F3	(DM 115,145) 66,289.70	93. 4.13	93.12.22	66,289.70	
19	EPLC System	1sys	IBRD/L-KOS -931010-F3	70,921	93. 5. 3	93.10.12	69,990.02	
20	Air Handling Unit	1set	IBRD/L-KOS -931206-F3	49,000	93. 5.19	93.10.16	48,216	
21	RFCO-Sputtering and Vapor Deposition System with Ion Gun	1set	IBRD/L-KOS -931404-F3	201,300	93. 6. 8	93.12.30	201,300	
22	MOCVD/CVD Co-operation System wi h and Installation Room	1sys	IBRD/L-KOS -940212-F3	KRW (246,485,030) 308,261	94.2.12	94. 5.30	305,698.91	
23	Industrial Balance with Recorder and Balance Table	1set	IBRD/L-9434	KRW 3,740,000	94.6.25	94.6.30	4,662.76	
24	Screw Compressor	1set	IBRD/L-9435	KRW 8,900,100			11,096.00	
25	486 DX2 P.C	1set	IBRD/L-9436	KRW 7,145,600			8,908.61	

3202-KO

Project Completion Report
Part II

June 15th, 1994

Korea Institute of
Geology, Mining & Materials

consultant's kind and timely assistance rendered to us in the implementation of our project, particularly when we encountered some kind of difficulties, has turned out to be very helpful and workable.

Thanks to his guidance and advice to the point of appropriateness, progress of our loan project has been satisfactorily well in terms of contracting, purchasing and disbursement. Now, we will glance at the implementation of our project in several ways.

1) Project Costs

Because of split of the old KIER into the KIGAM and the KIER(new) under the same Part D, LN 3202-KO, it is believed difficult to compare estimates and actual costs as different from other institutions.

However, although the KIGAM project and the KIER project have both proceeded well in schedule, it may still be useful to show a cost table as a whole, based on the Staff Appraisal Report of April 23, 1990.

Project Costs (US $ million)

Component	Appraisal Estimate		Actual Cost(KIGAM)		Percentage
	Local	For'n	Local	For'n	Change of Total
KIER(old)	0.9	9.7	0.3	6.4	- 30%

※ Most of the local costs was for customs clearance fees and in-land transportation and storage fees. Big differences seen in local funding cost are believed to have come from wider ranges of duty and tax exemption and tax decrease effected recently.

A. Objective of the Project

The purpose of the IBRD Loan Project, 3202-KO, for KIGAM, was to put a strong spur to its efforts to beef up its research capabilities in terms of acquirement of sufficient as well as up-to-date research equipment.

The component of the loan project valued at U.S.$ 6,400,000 has provided KIGAM with a total of 33 items of equipment, which account for about 25% of the 128 major research equipment now on hand.

In 1993 and into 1994, the 33 IBRD-funded equipment, which have all been delivered and installed in time, have been untilized in a wide range in carrying out KIGAM's major reseurch programs numbering roughly 100. For example, the Gas Isotope Mass Spectrometer, one of large equipment by the loan fund, has played a significant role on the project, "Determination on Stable Isotopes of Carbon and Hydrogen in Natural Gases."

As seen by a factual example, the strong input of the 33 IBRD equipment into KIGAM's research capabilities has, in fact, begun to bear fruit and will continue, in the years ahead, to be of great contribution toward KIGAM's research revitalization efforts.

B. Performance on Implementation

Throughout the project execution period from late 1990 to mid-1994, our component of LN 3202-KO has been well in progress, with international biddings, shipment and delivery of supplies as well as disbursements experiencing no big difficulties. We would like to mention in these connections that IBRD

2) Timeliness of Performance

On the whole, the KIGAM component of LN 3202-KO has shown steady progress as scheduled although there were a couple of instances where we had trouble receiving disbursements in time to our Special Account. Otherwise, all phases of the project implementation have been very much in schedule. Following is a bar table showing each phase of the implementation planned and drawn in late 1990, which at present in June 1994 almost come true to the fact.

Purchase Progress Schedule

	'91	'92				'93			
	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR	1st QTR	2nd QTR	3rd QTR	4th QTR
Equipment Specs Preparat'n									
Purchase Request to OSROK (2nd Package)									
Bids Opening at OSROK (Re-bidding, etc.)									
Bids Evaluat'n									
Successful Bids Winning									
Contract Awarding									
L/C Opening									
Shipping (1st and 2nd Packages)									
Applicat'n for Disbursements & Withdrawals									

3) Planned and Actual Completion Dates of the Component(KIGM)

Project Component	Planned Completion Date	Actual Completion Date	Months of Delay
Equipment	June 30, 1994	June 30, 1994	None

4) Technical Difficulties

No particular technical and/or managerial difficulties or shortcomings have been undergone by the KIGAM Procurement Section throughout the implementation period, which had full responsibilities for the Loan Project. There were, however, a couple of cases where the Special Account with Korea Exchange Bank was pressed hard for disbursement requests, while applications to IBRD for disbursements were put in for approval and payment action. We would like to mention in these connections again the kind and appropriate assistance and consultations provided by the IBRD mission represented by Mr. S. Z Sung throughout this loan implementation period.

C. Benefits from the Project

Most of the IBRD-funded equiment were brought in in 1993(one-third in 1992 ; 2-thirds in 1993), and it is rather difficult to see tangible benefits brought about by the IBRD equipment.

However, many of the equipment have already been utilized in research projects. Now, we will find out about the major, high-cost IBRD equipment utilized in research projects and increased number of research programs believed caused partly by the IBRD equipment as can be seen between 1992 and 1993.

1) Utilization of the Equipment

The IBRD equipment worth more than $200,000 and effectively used in research projects are as follows :

(a) Electron Probe X-Ray Micro-Analyzer

The EPMA, which is essential in qualitative and quantitative analysis of various kinds of minerals, is now of great use in the carrying out of the research project, "Metal Deposits Survey."

(b) Electron Beam Melting Furnace

The EB Furnace, which is used for remelting and making ingots and purification of metals and rare metals in particular, is at present playing an important role in the related project, "High Purity Rare Metals Development Project."

(c) Large Rock Mechanics Testing System

The system is now engaged effectively in the research activities on the shallow and deep-lying underground rocks to identify their dynamic properties and behaviors.

(d) Inductively Coupled Plasma-Mass Spectrometer

The ICP-MS, which has upgraded the micro-analysis from the previous ppm or sub-ppm to ppb-ppt, is expected to contribute greatly toward the development of high-purity industrial materials as well as the solution of environmental problems.

(e) Gas Isotope Mass Spectrometer

As brifly described above in the Objectives of the Loan Project, the Spectrometer is now valuably utilized in resources exploration and geochemical analysis activities. Related research Project, Determination on Stable Isotopes of Carbon and Hydrogen in Natural Gases.

We have just looked at several major IBRD equipment and their utilization status in our research activities. These equiment, however, along with other IBRD equipment, will be utilized more intensively in the future years, showing greater results on KIGAM's research achievement that is ultimately aimed at highly industrialized Korea.

2) Enhancement in Research Activities

Many of the IBRD-funded equipment began to be imported in 1992, and it is considered somewhat early to measure the effect of those research equipment on the research performance and achievement of KIGAM. However, it may be worthwhile to see the increasing trend in the number of research projects during 1992-1993, if not all thanks to the IBRD equipment.

Research Project Performances

Unit : 1,000 won

Year	Total : Amount / No.of projects	Remarks
1992	10,017,000 (194)	
1993	16,336,000 (214)	

※ Figures in parentheses indicate the number of projects

The increasing trend can also be seen in the sector of contract research from the outside ; increased from 73 projects in 1992 to 81 projects in 1993. With the passage of years, a strong thrust of the IBRD-funded research equipment which accounts for about 25% of all high-cost equipment will be more conspicuous and improve the research quality as well in the years to come.

IBRD Loan No. 3202-KO
PART C (KRISS Project)

Second Technology Advancement Project
Project Completion Report

(Part II : Project review from the borrower's viewpoint)

October 1994

Korea Research Institute of Standards and Science

Second Technology Advancement Project (Part C)
Project Completion Report (Loan 3202-KO)

1. Objective of the Project

KRISS is carrying out comprehensive R & D activities on measurement science and technology which are of great importance in the advanced industries of the 21st century - industries such as aviation and space science, micro-electronics, superconductors, optics, laser, precision instrumentation and development of new materials.

The objectives of this loan project are to strengthen R & D activities of the KRISS as well as to improve its capabilities in providing technical support to industry by acquiring up-to-date research equipments through IBRD loan, in order to meet the rapidly-growing demand of modern industry for advanced measurement technology.

2. Performance on Implementation

2-1. Allocation and disbursement of the loan

(Unit : US$1,000)

Year	'90	'91	'92	'93	'94	Total	Percentage (%)
Amount of the Loan Allocated	3,000	3,000	-	-	-	6,000	100%
Amount of the Loan Disbursed	-	600	5,336	63		5,999	99.9%

2-2. Comparision of the actual completion date of the project with the initally-planned completion date based on the Loan Agreement

	Planned Completion Date	Actual Completion Date	Remarks
Procurement of Equipment	June 30, 1994	September 1993	The project was completed 6 months earlier than expected
Installation of Equipment	June 30, 1994	December 1993	

2-3. Major equipments (more than US$300,000)

Items	Amount (US$1,000)	Equipment Installation
Molecular Beam Epitaxy Growth System	590	Epitaxial Semiconductor Research Group
Microstructure Analysis System for UHV Materials	353	Pressure & Vacuum Research Group
System for MEIS	335	Surface Analysis Research Group
$^3He/^4He$ Dilution Refrigerator	313	Superconductivity Research Group
Automatic Library System	308	Office of Technical Information

2-4. Managerial difficulties and some suggestions

As shown in the above tables, approximately 90 % of the fund allocated was used for the purchase of equipments in the year of 1992 and the project was successfully completed 6 months earlier than expected date on the Loan Agreement.

However, the limited amount of deposit in the special account (10% of total allocation contracted) concentrated on the short period had made it difficult to pay for the purchase of equipments.

It can be suggested therefore that the limited amount of deposit in the special account be increased up to 20 % of the total allocation for the smooth performance of the project.

3. Benefits from the Project

It is rather difficult to calculate numerically the benefits from this loan project at present. But most of the equipments has been utilized in many R & D projects for the improvement of the national measurement standards. More particular achievements can be evaluated in the long-term point of view.

The following tables are suggestive of the contribution of the project to the R & D activities in KRISS.

3-1. Comparision of the number of research paper published in national and international journals (or presented in conferences) after and before the project

	1990 (Before the Project)	1993 (After the Project)
National Journals	213	282
International Journals	81	127

3-2. Comparison of the number of patent produced after and before the project

	1977 ~ 1990 (Before the Project)	1991 ~ 1994 (After the Project)
National Patents	11	16
International Patents	1	2

4. Conclusion

For the improvement of the national measurement standards which plays a key role in modern high-tech industry aand for carrying out corresponding R & D activities, advanced facilities should be first equipped.

However, purchasing theses facilities requires a good deal of fund. In this respect, we trust the IBRD Loan Project was a great help for KRISS to fufill its functions of improving, maintaining and disseminating the national measurement standards as well as providing technical support to industry.

PART III

STATISTICAL INFORMATION
A. RELATED BANK LOANS

Table 1: IBRD/IDA LOANS/CREDITS RELEVANT TO THE PROJECT

Loan/Credit Number Project Title	Year of Approval	Purpose of Project	Status	Comments
Cr.151-KO First Education Project	1969	Expansion of vocational high schools, junior technical colleges and teacher training	Completed 09/76	Successful project Satisfactorily implemented.
Ln.906/Cr.394-KO Second Education Project	1973	Improvement of vocational high schools, junior technical colleges and science, engineering and education colleges.	Completed 12/79	Implemented substantially as planned. Line management evolved from Project Implementation Unit.
Ln. 1096-KO Third Education Project	1975	Expansion and quality improvement in vocational high schools, junior colleges and vocational training institutes (VTIs).	Completed 11/81	Successfully implemented with growing experience and competence of local staff.
Ln.1474-KO Vocational Training Project	1977	Further expansion of VTIs, and expansion and improvement of instructor training.	Completed 06/83	PCR concluded that the project was well designed, implemented efficiently and judged it to be an excellent example to Bank/Borrower.
Ln.1800-KO Sector Program on Higher Technical Education	1980	Improving technical colleges and colleges of engineering and management through supply of equipment,staff development, manpower planning, equipment maintenance and academic accreditation.	Completed 02/86	A sector program successfully implemented.
Ln.2427-KO Program for Science and Technology Education	1984	Raising quality of science and technology education to standards required by a more skill - and knowledge - intensive industrial system through planned policy and institutional change.	Completed 06/89	A second sector program successfully implemented with all planned policy and institutional changes fully achieved.
Ln.3037-KO Technology Advancement Project	1989	Strengthening the development of SMI in Technology-intensive sectors, improving the quality of education in a center of	Completed 12/93	Implementation experience of the project was highly satisfactory.

Loan/Credit Number Project Title	Year of Approval	Purpose of Project	Status	Comments
		excellence in science and engineering education and enhancing the capacity of selected R&D institutions to provide technical support to SMI.		
Ln.3203-KO University Science and Technology Research Project	1990	Enhancing basic research programs in selected universities in priority fields in science and technology and improving science teacher training.	Effective 11/08/90	Being implemented
Ln.3314-KO Vocational Education Project	1991	Upgrading the skill training provided in selected vocational high schools meeting the increasingly complex skill requirements of industry, commerce, agriculture and fisheries.	Effective on 09/03/91	Being implemented.
Ln.3315-KO Third Technology Advancement Project	1991	Improving the quality of research programs for developing advanced technologies, increasing opportunities for joint basic science research activities through common research facilities; and enhancing the development and application of industrial standards.	Effective on 09/03/91	Being implemented.
Ln.3468-KO Science Education and Libraries Computerization Project	1992	Raising the quality of science programs in secondary schools and universities and establishing and inter-library network system to enhance the access of information to students, faculty and researchers.	Effective on 09/09/92	Being implemented.
Ln.3469-KO Vocational Schools Development Project	1992	Continuing with the objectives in Ln.3314-KO to upgrade skill training in selected vocational high schools (VHS) and strengthening VHS system through five studies in five agreed areas.	Effective on 09/17/92	Being implemented.
Ln.3612-KO Environmental Research and Education Project	1993	Upgrading the capacity of selected agricultural & veterinary colleges to undertake research into key environmental problems, reinforcing the environmental aspects of basic science programs in the colleges and establishing appropriate arrangements for improving environmental	Effective on 09/03/93	Being implemented.

Loan/Credit Number Project Title	Year of Approval	Purpose of Project	Status	Comments
		research and training programs.		
Ln.3693-KO Science and Technical Education Project	1994	Improving science and technical education and research through implementation of an agreed policies and action program and the provision of specialized equipment.	Effective on 05/11/94	Being implemented.
Ln.3694-KO Environmental Technology Development Project	1994	Strengthening: a) selected national research institutes to identify and adequately address environmental issues and to undertake environmental R&D activities and b) the Ministry of Environment's policy and planning role.	Effective on 05/11/94	Being implemented.

B. PROJECT TIMETABLE

Table 2: PLANNED, REVISED AND ACTUAL DATES OF PROJECT TIMETABLE

ITEM	PLANNED	ACTUAL
Identification Mission	March 1989	March 1989
Preparation by Government	April-June 1989	April-June 1989
Pre-Appraisal Mission	June/July 1989	June/July 1989
Appraisal Mission	October/ November 1989	October/November 1989
Loan Negotiations	March 1990	March 1990
Board Approval	May 1990	May 1990
Loan Signature	August 1990	August 1990
Loan Effectiveness	November 1990	November 1990
Project Completion	June 1994	June 1994
Loan Closing [2]	June 1994	June 1994

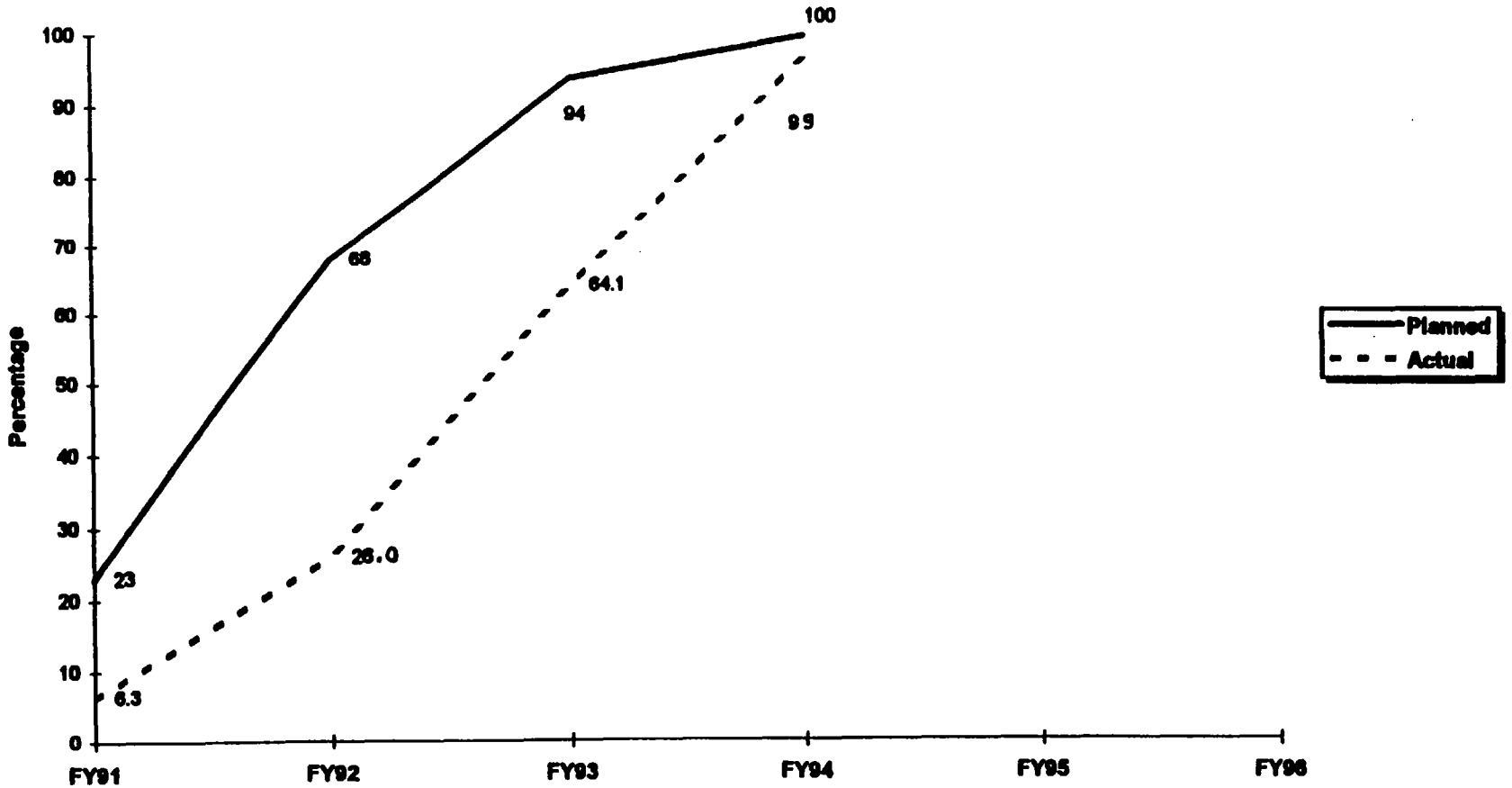
[2] The Loan Account was held open until August 31, 1994 for reimbursement of outstanding commitments. US$27,124.51 was cancelled.

C. LOAN DISBURSEMENTS

Table 3: CUMULATIVE ESTIMATED AND ACTUAL DISBURSEMENT

BANK FY	1991	1992	1993	1994
APPRAISAL ESTIMATES	6.2	20.5	28.6	31.6
ACTUAL	2.0	8.2	20.3	31.56
ACTUAL AS % OF ESTIMATE	32.3	40.0	70.9	99.9
DATE OF FINAL DISBURSEMENT	August 31, 1994.			
DATE OF LAST TRANSACTION FOR FULL RECOVERY OF THE INITIAL DEPOSIT OF US$1.1 million TO KAIST.	June 22, 1994			
DATE OF LAST TRANSACTION FOR FULL RECOVERY OF THE INITIAL DEPOSIT OF US$0.4 million TO GERI.	August 10, 1994			
DATE OF LAST TRANSACTION FOR FULL RECOVERY OF THE INITIAL DEPOSIT OF US$0.3 million TO KIER.	August 12, 1994			
DATE OF LAST TRANSACTION FOR FULL RECOVERY OF THE INITIAL DEPOSIT OF US$0.6 million TO KIGAM.	February 24, 1993			
DATE OF LAST TRANSACTION FOR FULL RECOVERY OF THE INITIAL DEPOSIT OF US$0.6 million TO KRISS.	October 28, 1994			

Time Line Planned and Actual Disbursement Schedule



D. PROJECT IMPLEMENTATION

Table 4: PLANNED AND ACTUAL COMPLETION DATES OF COMPONENTS a/

Project Components	Planned	Actual Completion Date	Months of delay Completion Date	Percentage (or advance) (--for advance)
Korea Advanced Institute of Science and Technology (KAIST)				
Equipment	December 1992	June 1994	17 months	
Genetic Engineering Research Institute (GERI)				
Civil Works	September 1990	n.a.		
Equipment	December 1992	June 1994	17 months	
Korea Institute of Energy Research (KIER)				
Equipment	December 1992	June 1994	17 months	
Korea Institute of Geology, Mining and Minerals (KIGAM)				
Equipment	December 1992	June 1994	17 months	
Korea Research Institute of Standards and Science (KRISS)				
Civil Works	September 1990	n.a.		
Equipment	December 1992	December 1993	12 months	

a/ There was no extension of Closing Date for this Loan.

E. PROJECT COST AND FINANCING

Table 5: PROJECT COSTS (US$ million)

Project Components	Appraisal Estimate			Actual Cost				Percentage Change of Total
	Local	Foreign	Total	Local	Foreign	Total		
Korea Advanced Institute of Science and Technology (KAIST)	1.3	14.2	15.5	n.a.	n.a.	n.a.	a/	
Genetic Engineering Research Institute (GERI)	1.6	5.0	6.6	n.a.	n.a.	n.a.	b/	
Korea Institute of Energy Research (KIER)	0.4	4.7	5.1	n.a.	n.a.	n.a.	c/	
Korea Institute of Geology, Mining and Minerals (KIGAM)	0.5	6.9	7.4	0.3	6.4	6.7	d/	-9.5%
Korea Research Institute of Standards and Science (KRISS)	3.6	7.6	11.2	n.a.	n.a.	n.a.	e/	
TOTAL	7.4	38.4	45.8	-	-	-		

a/ Not available as KAIST did not submit information as requested.
b/ Not available as GERI did not submit information as requested.
c/ Not available as KIER did not submit information as requested.
d/ Most of the local costs was for customs clearance fees, in-land transportation and storage fee which received tax exemptions.
e/ Not available as KRISS did not submit information as requested.

Table 6: PROJECT FINANCING (US$ million)

Source of Funds	Planned (as in SAR)	Final	Percentage Change of Total
IBRD Expenditure Categories			
Equipment	31.6	31.57	-0.1%
Domestic Financing a/			
Korea Advanced Institute of Science and Technology (KAIST)	n.a.	n.a.	n.a.
Genetic Engineering Research Institute (GERI)	n.a.	n.a.	n.a.
Korea Institute of Energy Research (KIER)	n.a.	n.a.	
Korea Institute of Geology, Mining and Minerals (KIGAM)	n.a.	n.a.	n.a.
Korea Research Institute of Standards and Science (KRISS)	n.a.	n.a.	n.a.
TOTAL	n.a.	n.a.	n.a.

a/ All five project institutions did not submit information requested.

Table 7: ALLOCATION OF LOAN PROCEEDS (US$million)

	Original Allocation	Actual [3] Disbursements
KAIST		
1. Equipment and materials under Part A of the Project	12,000,000	11,996,624.48
GERI[4]		
2. Equipment and materials under Part B of the Project	4,000,000	3,998,492.35
KIER[5]		
3. Equipment and materials under Part D of the Project.	3,200,000	3,188,869.73
KIGAM		
4. Equipment and materials under Part E of the Project	6,400,000	6,390,511.32
KRISS[6]		
5. Equipment and materials under Part C of the Project.	6,000,000	5,998,377.61
Subtotal	31,600,000	31,572,875.49
Amount of Loan Cancelled		27,124.51

[3] Based on memorandum from Bridie Champion, LOAAS to William E. Rees, EA1PH dated November 15, 1994.

[4] Genetic Engineering Center (GEC) has changed its name to Genetic Engineering Research Institute (GERI).

[5] The Korea Institute of Energy and Resource (KIER) has been divided into two institutes, the Korea Institute of Energy Research (KIER) and the Korea Institute of Geology, Mining and Materials (KIGAM).

[6] Korea Standards Research Institute (KSRI) has changed its name to Korea Research Institute of Standards and Science (KRISS).

F. PROJECT RESULTS

Table 8. DIRECT BENEFITS OF PROJECT

a) KAIST

The 370 items of equipment for KAIST to form the cornerstone of the laboratories and workshops for 20 academic departments, a computer center, and joint research labs. The increase in lab equipment per professor is equivalent to US$40,000 and US$2,200 per student. The total number of faculty increased from 298 in 1990 to 329 in 1994.

The number of research activities sponsored by government agencies and industry amounted to Won 32.8 billion and continues to increase. KAIST faculty published 1,524 articles in 1993 as compared to 1,117 articles in 1990.

b) GERI

The US$4.0 million of equipment supported by the project has assisted GERI in improving its R&D capacity.

	1990	1994
Recruitment of New Researchers	27	6
Total Researchers	129	143
Total Publications	65	130
R&D Budget (US$ million)	5.4	14.0
Number of projects	160	210

c) KIER and KIGAM

For both KIER and KIGAM, the project has positively supported the full range of their major activities. The 25 items of new equipment represent a key factor in strengthening the quality of KIER's research programs, especially in areas of new and renewable energy sources such as solar, wind, and methane gas. KIGAM has improved its work on geological mapping, oil and mineral resource surveys and the development of improved methodologies related to these activities. R&D capacity has also been enhanced in mining technology, especially related to coal. The 33 pieces of equipment supported by the project has contributed to the increasing volume of research projects from Won 10 billion (194 projects) in 1992 to Won 16.3 billion (214 projects) in 1993. In additional, the increasing trend is also evident in the number of contract research projects which grew from 73 in 1992 to 81 in 1993.

d) KRISS

The newly equipped laboratories have enhanced significantly the quality of research work at KRISS in ensuring product quality, safety and environmental standards. Its research publications increased from 294 journals in 1990 to 409 journals in 1993. Similarly, the number of patents produced also increased from 12 between 1977-1990 to 18 between 1991-1994.

G. STATUS OF LOAN COVENANTS

Table 9: STATUS OF LOAN COVENANTS

Section No. in Loan Agreement Dates,	Para No. in SAR	Description	Status of Compliance and Deadline if applicable
4.01 and each para. 6 of the Amendment of the Loan Agreement	3.16	Furnish to Bank annual Audit Reports including separate opinion on Statements of Expenditure and certified copies of financial statements.	By June 30 of each year. In full compliance.
5.01	3.9	Manage each project component under supervision of qualified and experienced staff and with adequate numbers of competent supporting staff	In full compliance.

H. USE OF BANK RESOURCES

Table 10: STAFF INPUTS BY STAGE OF PROJECT CYCLE IN STAFF WEEKS

Stage of Project Cycle	Planned			Final		
	HQ	Field	Total	HQ	Field	Total
Through Appraisal	N/A	N/A	37	5.0	5.0	10.0
Appraisal -Negotiations	N/A	N/A	4	2.5	3.8	6.3
Negotiations -Loan Signing	N/A	N/A	2	0.2	-	0.2
Supervision	N/A	N/A	29	9.1	3.5	12.6
PCR	N/A	N/A	7	-	0.4 -	3.6
Others (Project Admin.)	N/A	N/A	2	3.7	-	3.7
Total	N/A	N/A	81	20.5	8.9	29.4

Table 11: MISSION DATA BY STAGES OF PROJECT

Mission	Month/Year	No. of Person [7]	Staff Weeks in Field		Performance Status by Activity [8]			
Identification	3/89	2 (PE, TE)	2.8					
Preparation (by Gov)	4/89 - 6/89	-	-					
Pre-appraisal	6/89 - 7/89	4 (PE,TE,EE,TPS)	3.8					
Appraisal	10/89 - 11/89	3 (PE,TE,EE)	2.2					
Subtotal			8.8		F	M	I	G
Supervision I	9/90	1 (TE)	0.1		1	1	1	1
Supervision II	2/91 - 3/91	2 (PE,TE)	0.5		1	1	1	1
Supervision III	10/91 - 11/91	3 (PE,TE,ITS)	0.5		1	1	1	1
Supervision IV	5/92 - 6/92	1 (TE)	1.0		2	1	1	1
Supervision V	5/93	1 (TE)	0.1		1	1	1	1
Supervision VI	10/93	1 (TE)	0.5		1	1	1	1
	Subtotal		2.7	Avg.	1.2	1	1	1
PCR	11/94	1 (TE)	1.0					
	Total		3.7					

[7] PE= Principal Economist; TE = Technical Educator; ITS = Industrial Training Specialist; EE = Engineering Educator; and TPS = Technology Policy Specialist.

[8] F = Financial; M = Managerial; I = Development Impact; G = Overall Status

ANNEX 1

PROJECT COMPLETION REPORT

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3202-KO)

PARTICIPANTS IN COMPLETION MISSION[1/]

World Bank

Sing-Zak Sung, Consultant, Technical Educator

Korea Advanced Institute of Science and Technology

Nam-koo Lee, Chief, Public Relations & International Cooperation Office

Genetic Engineering Research Institute

Hun-Pyo Ha, Chief, R&D Management Section

Korea Institute of Energy Research

Yung-Gwen Oh, Chief, Procurement Division

Korea Institute of Geology, Mining and Materials

Tae-Ha Chu, Chief, Procurement Division

Korea Research Institute of Standards and Science

Pil-Gean Jung, Director, Department of Planning and Research Management

1/ The completion mission was undertaken as part of the completion mission for the Third Technology Advancement Project and supervision mission for two Health Technology Projects in April/May 1994.

ANNEX 2

PROJECT COMPLETION REPORT

KOREA

SECOND TECHNOLOGY ADVANCEMENT PROJECT
(Loan 3202-KO)

RECORD OF PROGRESS REPORTS SUBMITTED

1. Status Report from Korea Standards Research Institute (KSRI), September 1990.

2. Status Report from Korea Institute of Energy and Resources (KIER), September 1990.

3. Status Report from Korea Advanced Institute of Science and Technology (KAIST), September 1990.

4. Status Report from Genetic Engineering Center (GEC), September 1990.

5. Sub-loan Agreement between KAIST and Ministry of Finance (MOF) Korea, July 1990. {KAIST on behalf of Korea Institute of Technology (KIT) for KIT's part in Loan 3037-KO, since KIT merged with KAIST soon after signing of the loan}.

6. Status Report from Korea Advanced Institute of Science and Technology (KAIST), February 1991.

7. Status Report from Korea Standards Research Institute (KSRI), March 1991.

8. Status Report from Korea Institute of Energy and Resources (KIER), February 1991.

9. Status Report from Genetic Engineering Center (GEC), February 1991.

10. Status Report from Korea Advanced Institute of Science and Technology (KAIST), October 1991.

11. Status Report from Korea Standards Research Institute (KSRI), October 1991.

12. Status Report: Copies of a)Decree from MOST minister to KRISS for approval of Amendment of Articles of Association in English and Korean versions; b) new organization chart for KRISS.

13. Status Report of IBRD Loan Project (LN 3202-KO)
Copies of:
a) present status of KIER, October 1991;

b) a new status of KIER, November 1991;
c) a new status of KIGAM, November 1991;
d) present status of KIGAM/KIER, November 1991; and
e) Genetic Engineering Research Institute, November 1991.

14. Status Report from Korea Advanced Institute of Science and Technology (KAIST), May 22, 1992.

15. Procurement Status of Equipment and Summary Status of Special Account from Korea Research Institute of Science and Standards (KRISS), May 19, 1992.

16. Status Report from Korea Institute of Energy Research (KIER), May 18, 1992.

17. Status Report from Korea Institute of Geology, Mining and Materials (KIGAM), May 10, 1992.

18. Status Report from Genetic Engineering Research Institute (GERI), May 1992.

20. Status Report from Korea Advanced Institute of Science and Technology (KAIST), May 15, 1993.

21. Summary Status of Disbursement and the Status of Research Equipments Procured from Korea Research Institute of Science and Standards (KRISS), May 19, 1993.

22. Status Report from Korea Institute of Energy Research (KIER), Jan 28, 1993.

23. Status Report from Korea Institute of Geology, Mining and Materials (KIGAM), May 15, 1993.

24. Status Report from Genetic Engineering Research Institute (GERI), May 1993.

25. Status Report from Korea Advanced Institute of Science and Technology (KAIST), October 11, 1993.

26. Summary Status of Disbursement and the Status of Research Equipments Procured from Korea Research Institute of Science and Standards (KRISS), October 11, 1993.

27. Status Report from Korea Institute of Energy Research (KIER), October 15, 1993.

28. Status Report from Korea Institute of Geology, Mining and Materials (KIGAM), October 10, 1993.

29. Status Report from Genetic Engineering Research Institute (GERI), October 1993.

30. Status Report from Korea Advanced Institute of Science and Technology (KAIST), May 3, 1994.

31. Status Report from Korea Institute of Energy Research (KIER), May 3, 1994.

32. Status Report from Korea Institute of Geology, Mining and Materials (KIGAM), May 2, 1994.

33. Status Report from Genetic Engineering Research Institute (GERI), May 1994.

IMAGING

Report No: 14756
Type: PCR